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TEST AND EVALUATION REPORT

MONOCULAR RAPID ALIGNMENT DEVICE (MONORAD)

T & E REPORT NO. 69-03

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Approved For Release 2005/02/17 : CIA-RDP78B04770A001400010033-1

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APRIL 1969

TEST AND EVALUATION BRANCH

ESD/TSSG/NPIC

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FIGURES

1. INTRODUCTION

1.1. The Monocular Rapid Alignment Device (MonoRad), Fig. 1, was built by the [redacted] 25X1 This MonoRad was tested by TEB between 19 November 1968 and 18 December 1968. The contract specifications were used as a guide-line for the tests. Reference 2 is a report on the operational evaluation which was received in March 1969 is incorporated in this report as Section 4.

1.2. Due to the press of time to pay the contractor, the contract monitor and TEB agreed on 11 December 1968 to a reduced level and depth of acceptance testing. A large amount of time was saved by eliminating the optical performance tests of the MonoRad when mounted on the Zoom 70 instrument.

1.3. The present report contains Reference 3 largely as Sections 2 and 3. The acceptance testing included physical, optical, graphic, human factors, and maintainability requirements. The engineering evaluation section includes discussion of some reliability factors as well as possible improvements in the construction and use of the MonoRad.

REFERENCES: 1. ESD/TEB Test Plan - dated 22 October 1968.
2. Memorandum - IEG/77-69 dated 5 March 1969.
3. Memorandum - NPIC/TSSG/ESD/TEB-34-68 dated 24 December 1968.

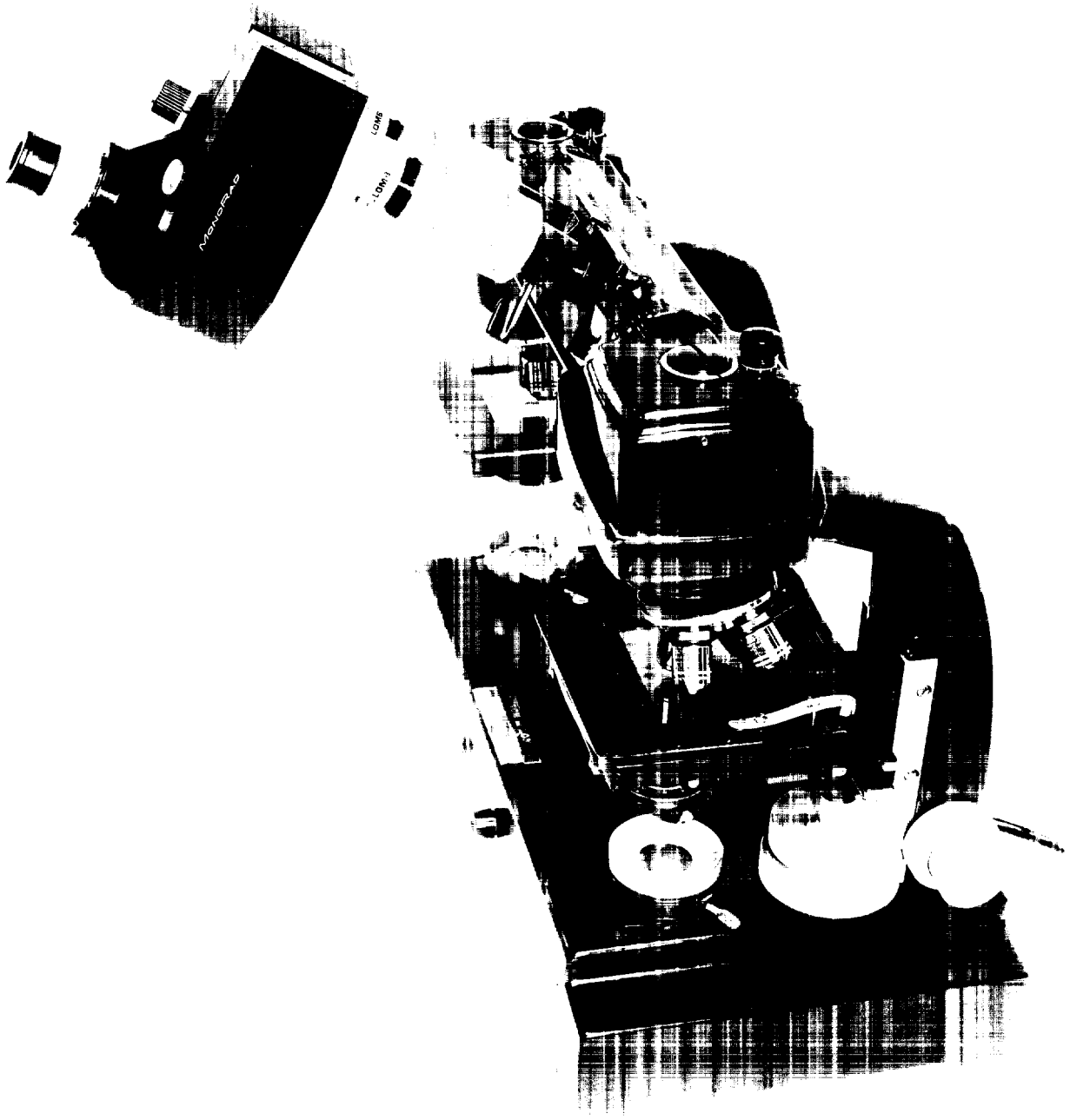

Figure 1 - MonoRad Mounted on a HPS Equipped With Anamorphic Eyepiece Attachments

2. TEST RESULTS

25X1 (NOTE: The [ ] High Power Stereoviewer is referred to herein as HPS)

2.1. Physical Requirements

ITEM	TEST RESULTS	CONTRACTUAL REQUIREMENT
Dimensions	$7\frac{1}{4}$" wide, 4 3/8" min. height (excluding 1 3/16" for a portion that fits into the microstereoscope eyepiece tube), and $5\frac{1}{4}$" deep.	7" wide, $4\frac{1}{2}$" high, 4" deep.
Weight	3 lbs. 7.77 oz.	$\leq 3\frac{1}{2}$ lbs.
IPD Compatibility (Interpupillary distance)	The straight-through IPD range of the MonoRad is 56 to 82+ mm. The HPS IPD range is 54 to 74 mm. and the MonoRad is compatible with this. The G.P. anamorphic attachment IPD range is 46 to 69 mm. and the MonoRad is compatible from only 62.5 to 69 mm.	50 to 75 mm.
Mechanical compatibility	The MonoRad is mechanically compatible with the specified eyepieces and anamorphic attachments. The [ ] advanced anamorphic attachment could not be mounted on the Zoom 70, so DED waived this portion of the test.	Eyepieces [ ] 10X wide field, [ ] 6X compensating or 10X compensating, wide field, high eye point. 25X1 25X1 25X1 Anamorphic attachments [ ] 25X1

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ITEM	TEST RESULTS	CONTRACTUAL REQUIREMENT
Connection mechanism Disconnection mechanism	It requires moderate care and a few seconds to connect or disconnect the MonoRad.	Quick and Easy Quick and convenient
Focus adjustments	Three focus adjustments were provided. The full range of the channel focus knobs requires seventy (70) 360° turns.	In viewing eyepiece and both input tubes.
Paint	The contractual requirement for finish appears to be what was provided.	Black semi-gloss enamel on all non-mating external surfaces.
Internal coating	The MonoRad was not disassembled. According to the drawings the non-Teflon, non-stainless steel, and non-Dynaco parts are generally black anodized. The input tubes are clear anodized. Many reflecting internal surfaces are visible through the input ports. See section 3.6.	Non-reflecting black material on all non-reflecting and non-transmitting internal surfaces.
Structural rigidity	Appears structurally rigid except for the two channel focusing shafts. The knobs wiggle back and forth very easily and it is possible to place the MonoRad on the table such that these knobs get banged. The 303 stainless steel 0.1875 "shaft rides in a 0.1876" 2024-T4 aluminum hole that is only 0.156 inches deep per the drawings. During the acceptance testing reported here the MonoRad was mounted on the HPS 44 times and on the Zoom 70 five times. No optical misalignment due to jarring was observed.	Sufficient to withstand the jarring resulting from repeated disconnection and placement on convenient nearby surfaces. The optical elements shall maintain alignment.
Hardware	Most screws are 4-40 and the larger size threads are $1\frac{1}{4}$"-18NEF3 and 1 13/16"-	Screws, bolts, etc. shall be of a minimum number of types and sizes.

American Standard. shall be American Standard.

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ITEM	TEST RESULTS	CONTRACTUAL REQUIREMENT
Surfaces	The aluminum and painted surfaces are judged satisfactory for corrosion resistance.	Corrosion susceptible surfaces are to be suitably treated.
Bearings	The only visible bearings are Teflon. There are several stainless steel shafts which ride directly in 2024-T4 aluminum.	Sealed bearings of the prelubricated type shall be used wherever possible.
Case	A storage case was provided. With a handle it would make a fine carrying case.	A carrying and/or storage case shall be provided.
Material	The drawings specify 2024-T4 aluminum which is a wrought material.	356 Al alloy castings.
2.2. Optical Requirements		
Resolution ratio	The resolution ratios ranged from 0.40 to 0.89 with two out of 16 cases being within specs. Physically supporting the MonoRad improved the ratios (in one case to 1.00). See section 3.5.	Ratio of resolution with and without the MonoRad shall be ≥ 0.8.
Light level ratio	The light level ratios ranged from 0.079 to 0.087. The average per cent light transmission was 8.3%. See section 3.6.	Ratio of the sum of light levels through the eyepieces to that through the MonoRad shall be ≥ 0.4.
Field of view ratio (FOV)	For eight different optical settings the FOV ratio was 1.0 or greater.	Ratio of FOV diameter with and without the MonoRad shall be ≥ 0.95.
Defocusing	For four different optical settings connection and disconnection of the MonoRad caused no defocusing of either the HPS or the MonoRad.	No defocusing after connection or disconnection of the MonoRad.

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ITEM	TEST RESULTS	CONTRACTUAL REQUIREMENT
Magnification	In the three out of four optical settings the magnification through the MonoRad was 90% of that through the HPS.	Shall not change the magnification range of the microstereoscope. The Image will be relayed at unity magnification.
Orientation	An image rotation of 1 to 2° was measured through the green channel. None through the white channel.	Shall not change the orientation of the image.
Anamorphic	For two optical combinations there were no changes in the required anamorphic settings. Physical movement of the anamorphic magnification control was sometimes observed.	Connection and disconnection shall not change the anamorphic adjustment.
Color code	One channel is coded with a green filter. The other channel shows predominately the color of the illuminating light. The latter channel is called the white channel.	Each optical channel shall be color coded.
2.3. Graphic Requirements		
Books	Test was waived.	Instruction books shall conform to good commercial practice.
Drawings	N/A	None
2.4. Human Factors		
Viewing height	The MonoRad can be mounted in an "up" and a "down" position. The "down" position (shown in Figure 1) does not significantly change the operator's eye position in the vertical direction from what it was prior to attachment of the MonoRad.	Comfortable.

ITEM	TEST RESULTS	CONTRACTUAL REQUIREMENT
Safety	No sharp edges or other safety hazards were found.	Sharp edges and corners shall be broken.
"Feel"	The two channel focusing knobs wobble as they rotate and even at maximum (200X) magnification seem to turn interminably before any noticeable change in focus occurs. See section 3.4.	Rotational resistance for correct operator "feel".

2.5. Maintainability

Alignment, etc.	Manuals state that the sealed unit should be returned for repair if it is not functional. Thus no special accessories are needed.	Special tools, fixtures, or instruments shall be considered part of the prototype MonoRad.

3. ENGINEERING EVALUATION OBSERVATIONS

3.1. Repeated connection and disconnection of the MonoRad a half dozen or so times caused the interpupillary distance setting on the HPS to change from 68mm to 60mm. This did not destroy the anamorphic settings obtained with the MonoRad.

3.2. Adjusting the anamorphic attachments unscrews the MonoRad input tube adapters if they are not firmly tightened.

3.3. If the MonoRad is stored on a table instead of in its case, it will suffer the least damage due to jarring if always placed on its back surface. (This is the hinged end).

3.4. The fine focus knobs in the white and green color coded channels have a range of 70 full 360° turns, and require many turns to obtain any noticeable change in focus. It is best to get them roughly in the middle of their range and use the focusing ring on the eyepiece tube to obtain an average focus before touching up the focus for each optical channel with the individual fine focus knobs.

3.5. The resolution improves significantly when the weight of the MonoRad is not borne by the [redacted] advanced anamorphic attachment on the HPS. It would be best to use some mechanical means of support when the operator is engaged in the critical task of adjusting the anamorphic settings. 25X1

3.6. The light loss through the MonoRad is very large. This will, of course, hurt its application to low contrast imagery. Figures 2 and 3 show the laser setup and the multiple laser reflections that were observed. This indicates that some of the light loss could be eliminated in production versions of the MonoRad. It would be best to test the operational suitability of the concept rather than the prototype by using high contrast imagery for the operational suitability test.

3.7. The optical maintenance technician cleaned the externally accessible optical surfaces. He noted that the inaccessible interior surfaces were very dirty.

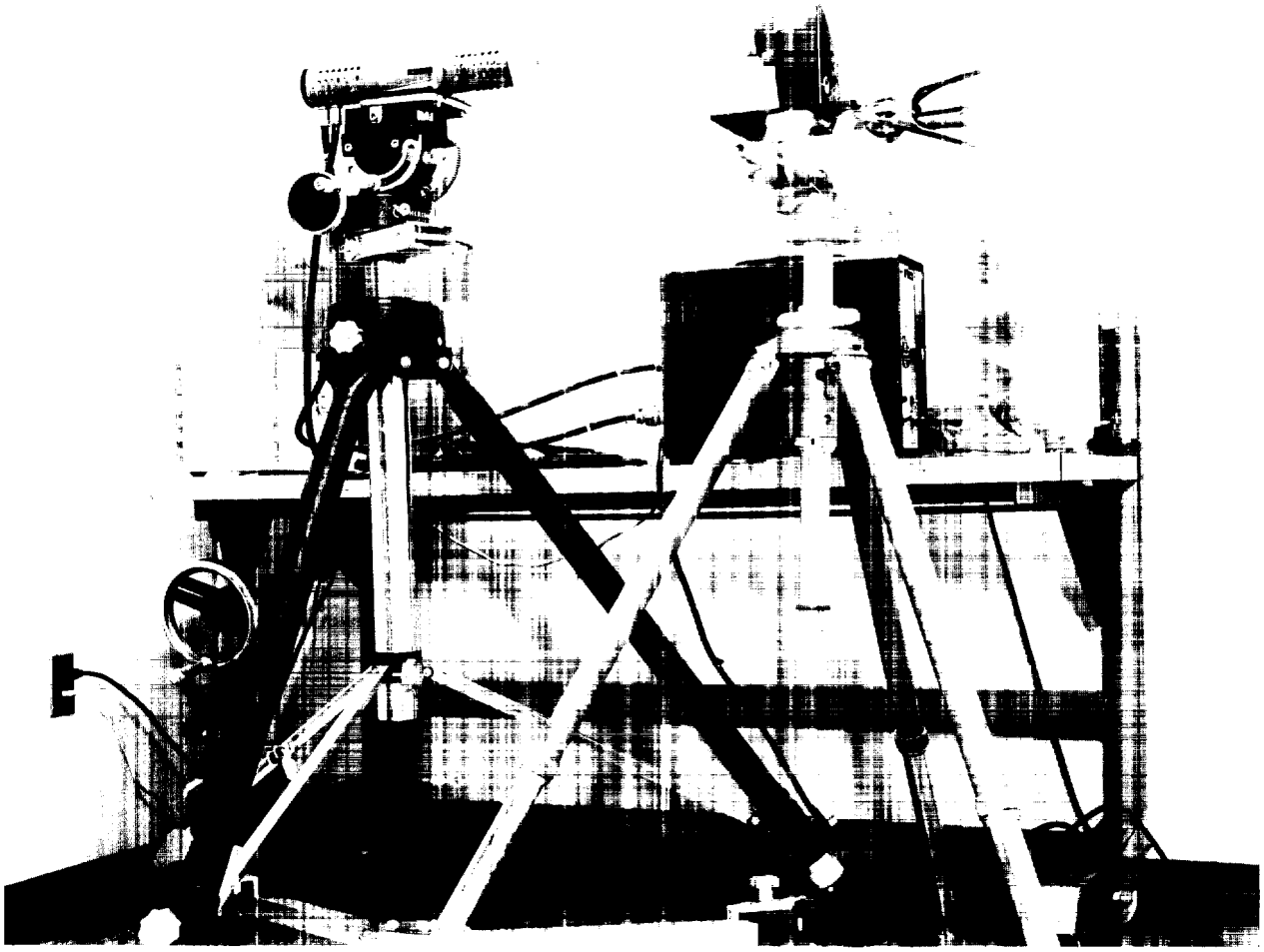

Figure 2 - Tripod Mounted Laser
and MonoRail

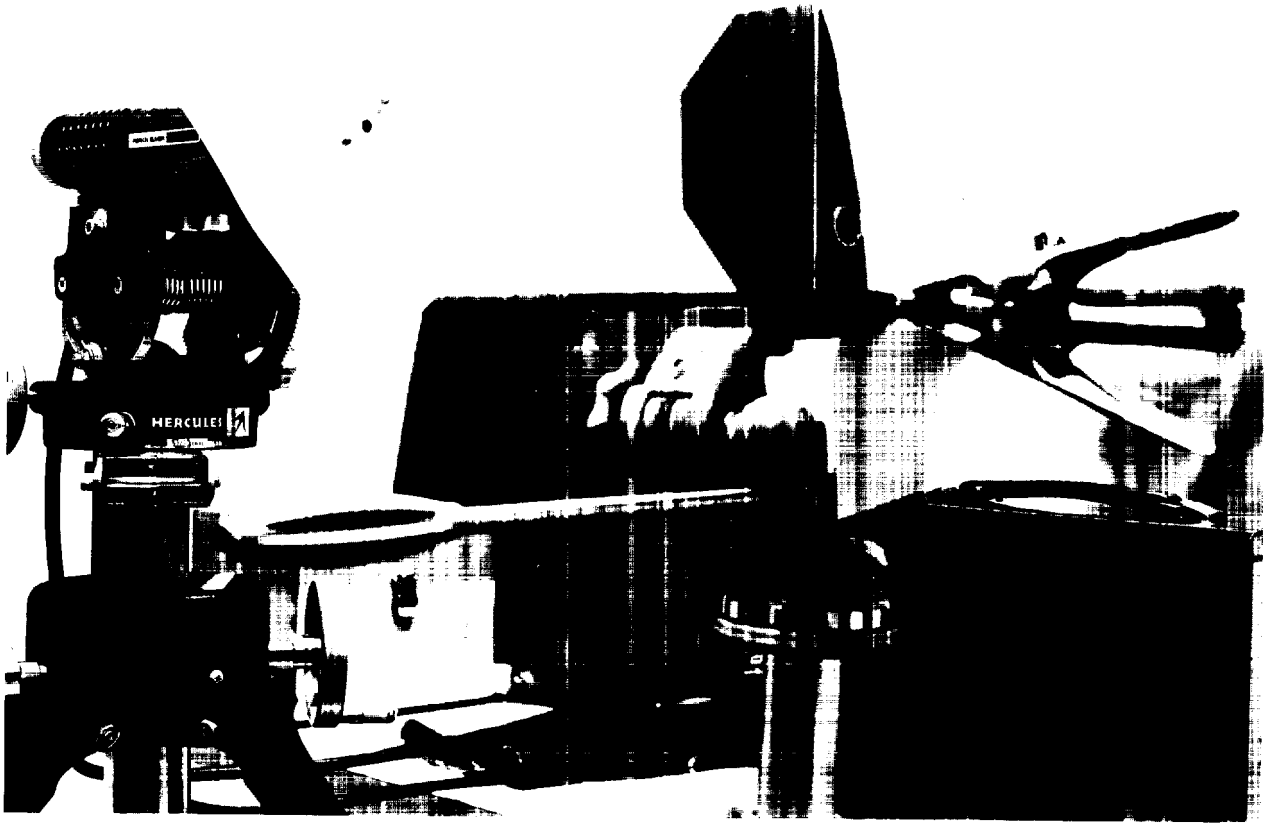

Figure 3 - Single Laser Spot Throughput and the Brightest Four of the Seven Laser Reflections

4. OPERATIONAL SUITABILITY REPORT

The body of the report received from the operating divisions that performed the operational evaluation is reproduced here in its entirety.

4.1. The Imagery Exploitation Group is able to forward only a partial evaluation of the MonoRad. As you are aware, this instrument was available to the Scientific Division and the Missiles and Space Division only. The evaluation included not only conventional imagery but also bicolor material.

4.2. Results of the evaluation from the Scientific Division indicated that the MonoRad was of marginal value. Use of the MonoRad with bicolor imagery was difficult because the exacting requirements for alignment of the imagery. The Missiles and Space Division examined the attachment and found it more time consuming than using the current method of stereo alignment. Stereoscopic alignment of oblique imagery can be more readily accomplished without the use of the MonoRad.

4.3. In conclusion, the Imagery Exploitation Group recommends that the MonoRad project be discontinued. Responses from the divisions indicates that a modified version (lighter and smaller) would also not be desirable.

5. CONCLUSIONS AND RECOMMENDATION

5.1. TEB had concluded that the MonoRad was suitable for operational suitability testing of the concept with certain provisos.

5.2. TEB had further concluded that the device is not acceptable from an engineering viewpoint. Certain design modifications are in order to correct the various deficiencies reported.

5.3. The Imagery Exploitation Group recommends that the MonoRad project be discontinued (see Section 4 above).

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